



OFFICE OF  
**RIVER PROTECTION**  
United States Department of Energy

# Hanford Site Waste Management Area C Performance Assessment Current Status

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Wednesday, January 7, 2015





## Presentation Outline

- Background and Status: Waste Management Area C (WMA C) Performance Assessment
- Selected Topics
  - Tank and grout degradation modeling approach
  - Evaluating effects of vadose zone heterogeneities on model results





# Hanford Site Tank Farms

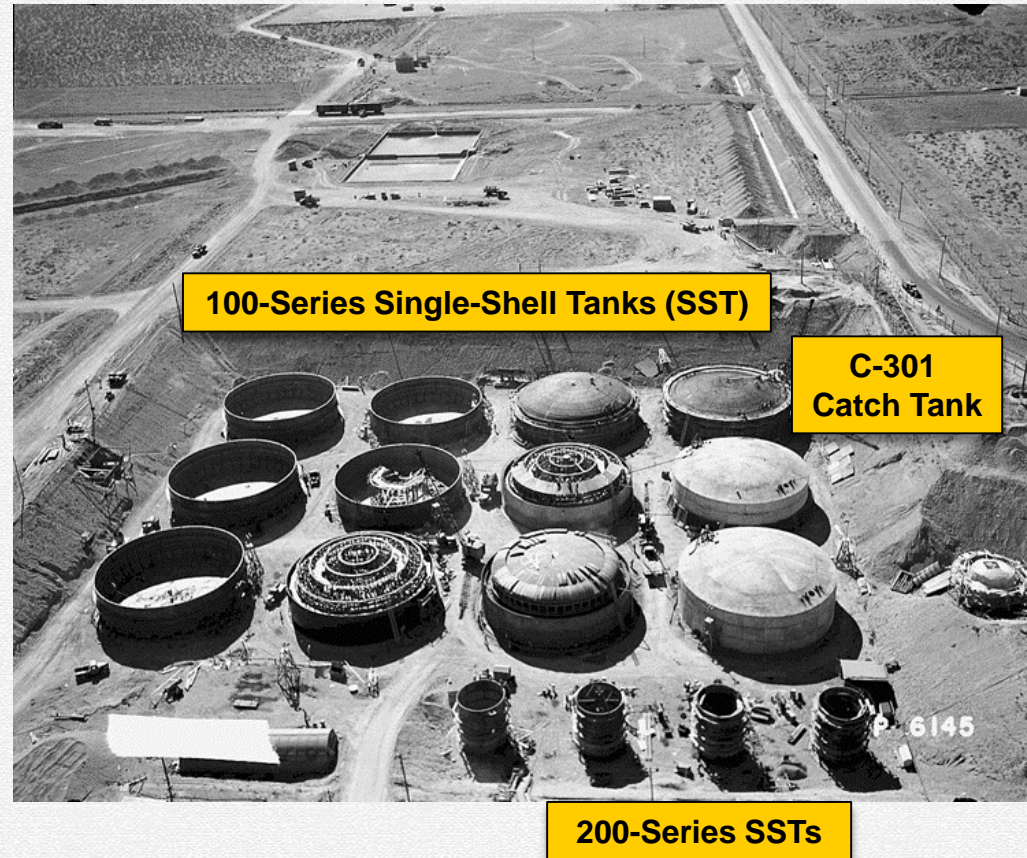






## Waste Management Area C Operational History

- Constructed in 1943–1944
- Operated from 1946 through mid-1980s storing and transferring waste
- Due to long operational history, WMA C received waste generated by essentially all of the Hanford Site major chemical processing operations







# Waste Management Area C Operational Period Releases

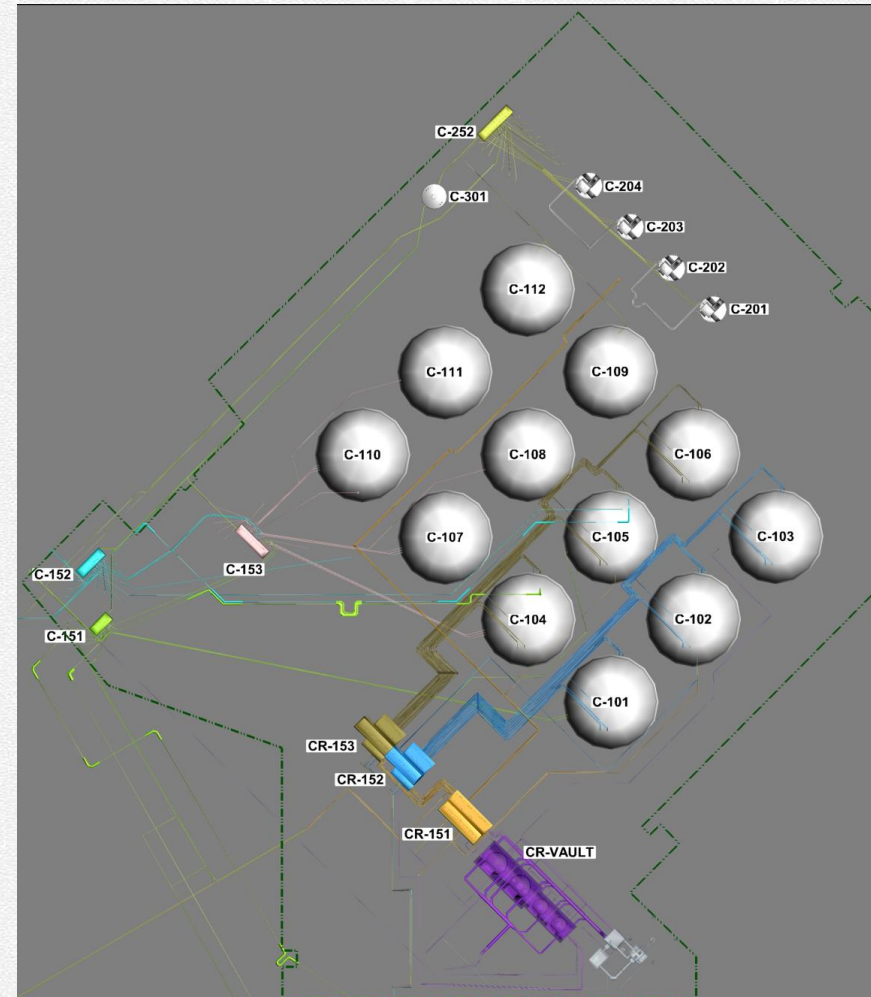
## Summary of Past Releases

|        |   |            |
|--------|---|------------|
| C-101  | → | 37,000 Gal |
| C-104  | → | 28,000 Gal |
| C-105  | → | 2,000 Gal  |
| C-108  | → | 18,000 Gal |
| C-110  | → | 2,000 Gal  |
| C-112  | → | 7,000 Gal  |
| UPR-81 | → | 36,000 Gal |
| UPR-82 | → | 2,600 Gal  |
| UPR-86 | → | 17,000 Gal |

**Total Releases → 149,600 Gal**

RPP-ENV-33418, 2014, *Hanford C-Farm Leak Assessments Report, Rev. 3.*

(RPP = River Protection Project)







# Waste Management Area C Retrieval Status



## Ten SSTs

- Retrieval complete
- Inventory based on sampled residuals and final residual volumes
- Seven tanks with release rate studies<sup>1</sup>



## Three SSTs

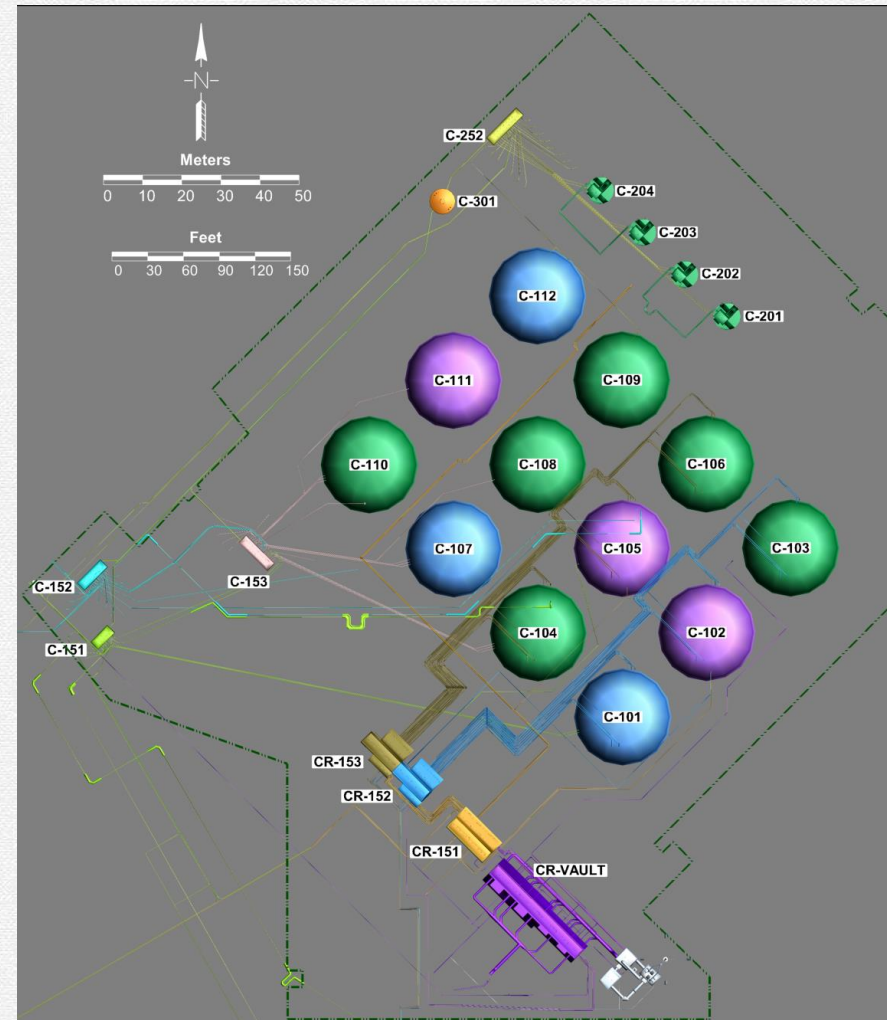
- Retrieval complete and sampling underway
- Inventory estimated from chemical process knowledge and final residual volumes



## Three SSTs

- Retrieval ongoing
- Inventory estimated from chemical process knowledge and estimated volume at closure

<sup>1</sup> Pacific Northwest National Laboratory has completed release rate studies on tank residuals for Tanks C-103, C-106, C-108, C-109, C-202, C-203, and C-204, and is starting on C-104





## Residual Inventories of Key COPCs at Closures

|                                        | Technetium-99 (Ci) | Total Uranium (kg) | Chromium (kg)   |
|----------------------------------------|--------------------|--------------------|-----------------|
| Retrieved SSTs                         | 7.81E-01           | 4.92E+03           | 7.26E+01        |
| SSTs Undergoing Retrieval <sup>1</sup> | 1.00E+00           | 1.07E+03           | 2.62E+01        |
| Ancillary Equipment                    | 5.45E-02           | 1.08E+03           | 2.94E+01        |
| Pipelines                              | 4.61E-02           | 9.12E+02           | 2.49E+01        |
| <b>Total</b>                           | <b>1.88E+00</b>    | <b>7.98E+03</b>    | <b>1.53E+02</b> |

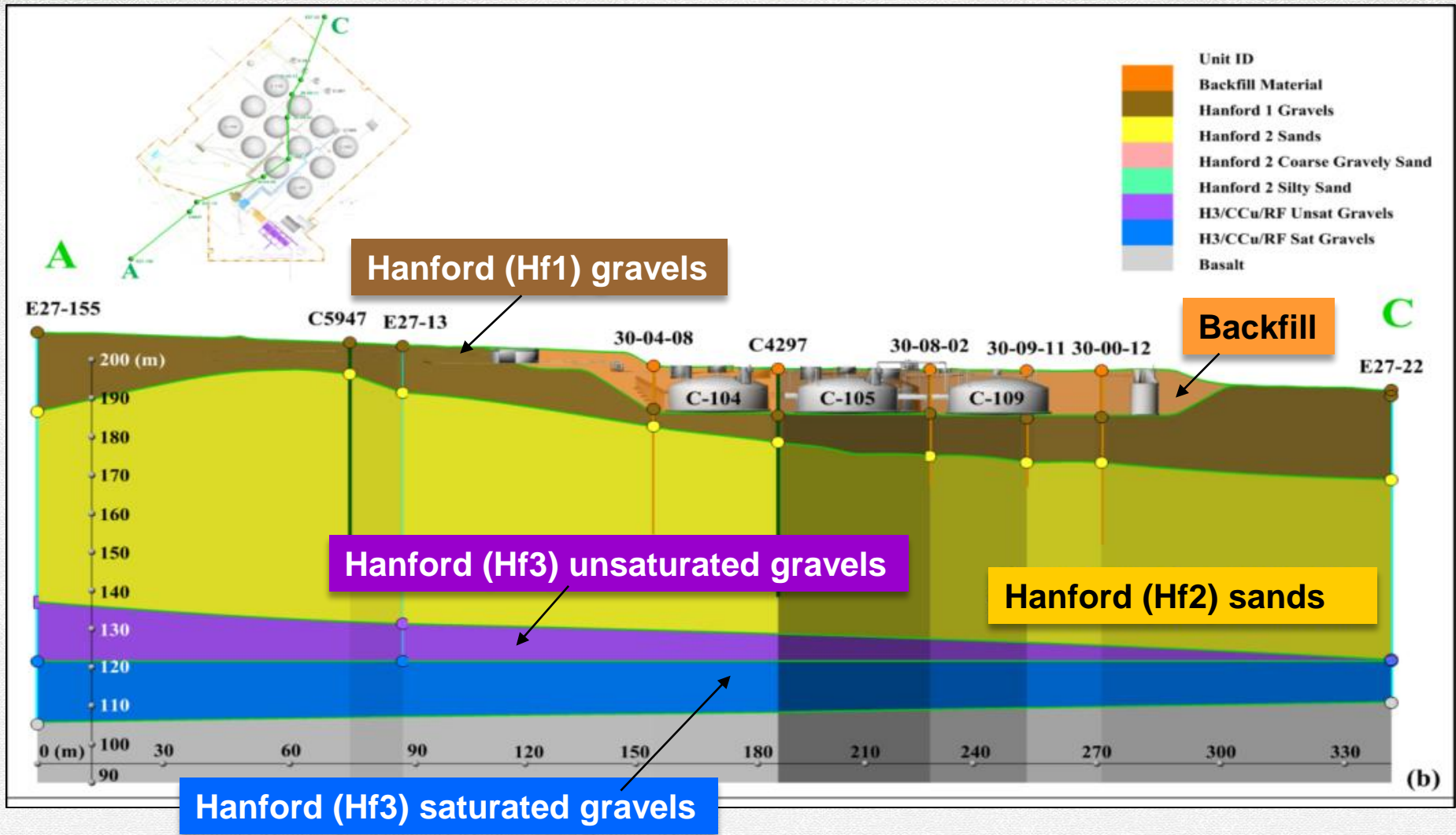
<sup>1</sup> Inventory estimated using regulatory goal for retrieval of approximately 2,700 gals.

RPP-RPT-42323, 2014, *Hanford C-Farm Tank and Ancillary Equipment Residual Waste Inventory Estimates*, Rev. 2.

COPC = chemical of potential concern.







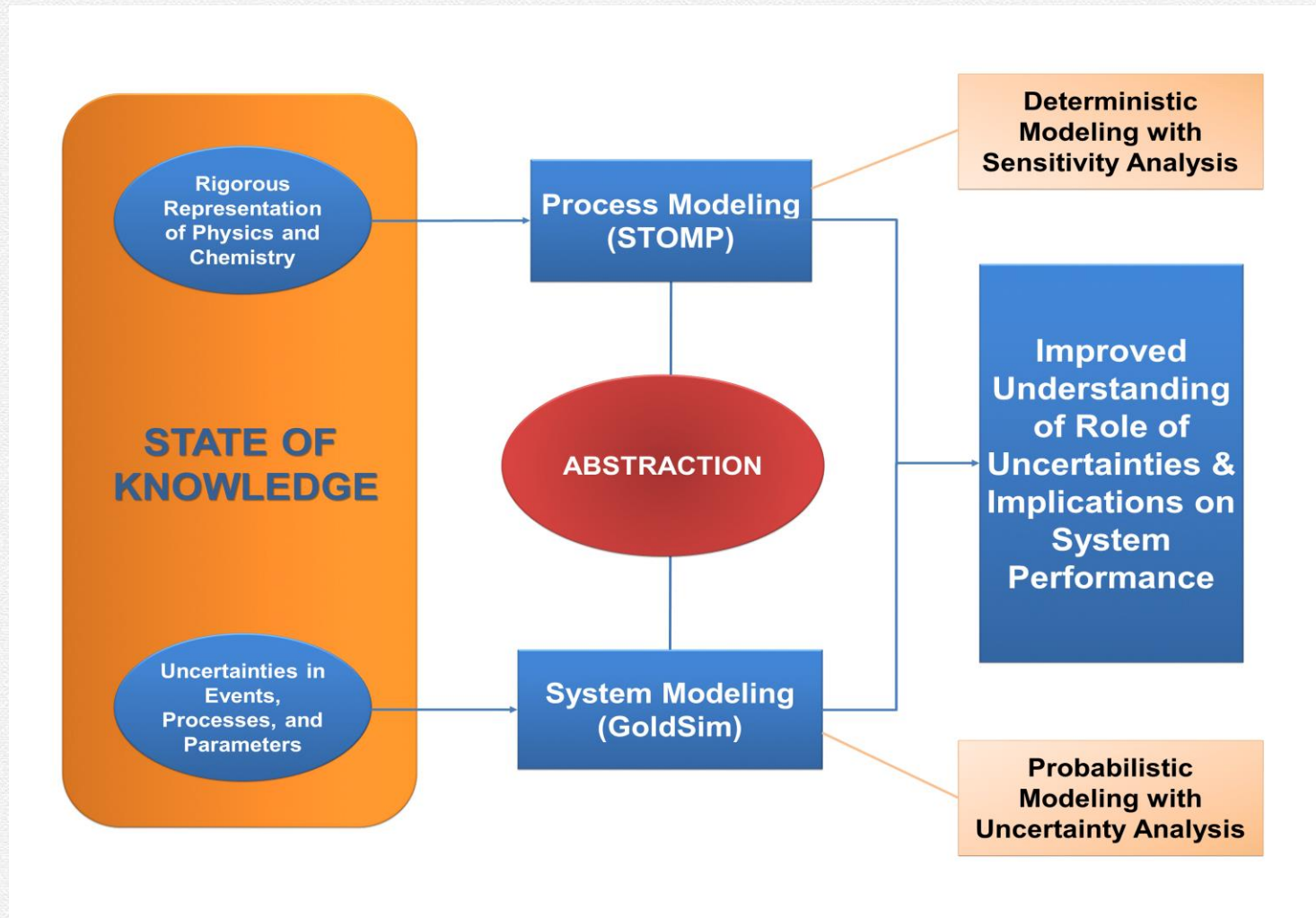
RPP-RPT-56356, 2014, *Development of Alternative Digital Geologic Models of WMA C*, Rev. 0.







# Complimentary use of Process-Level and System-Level Models







# Performance Assessment Approach with Numerical Model

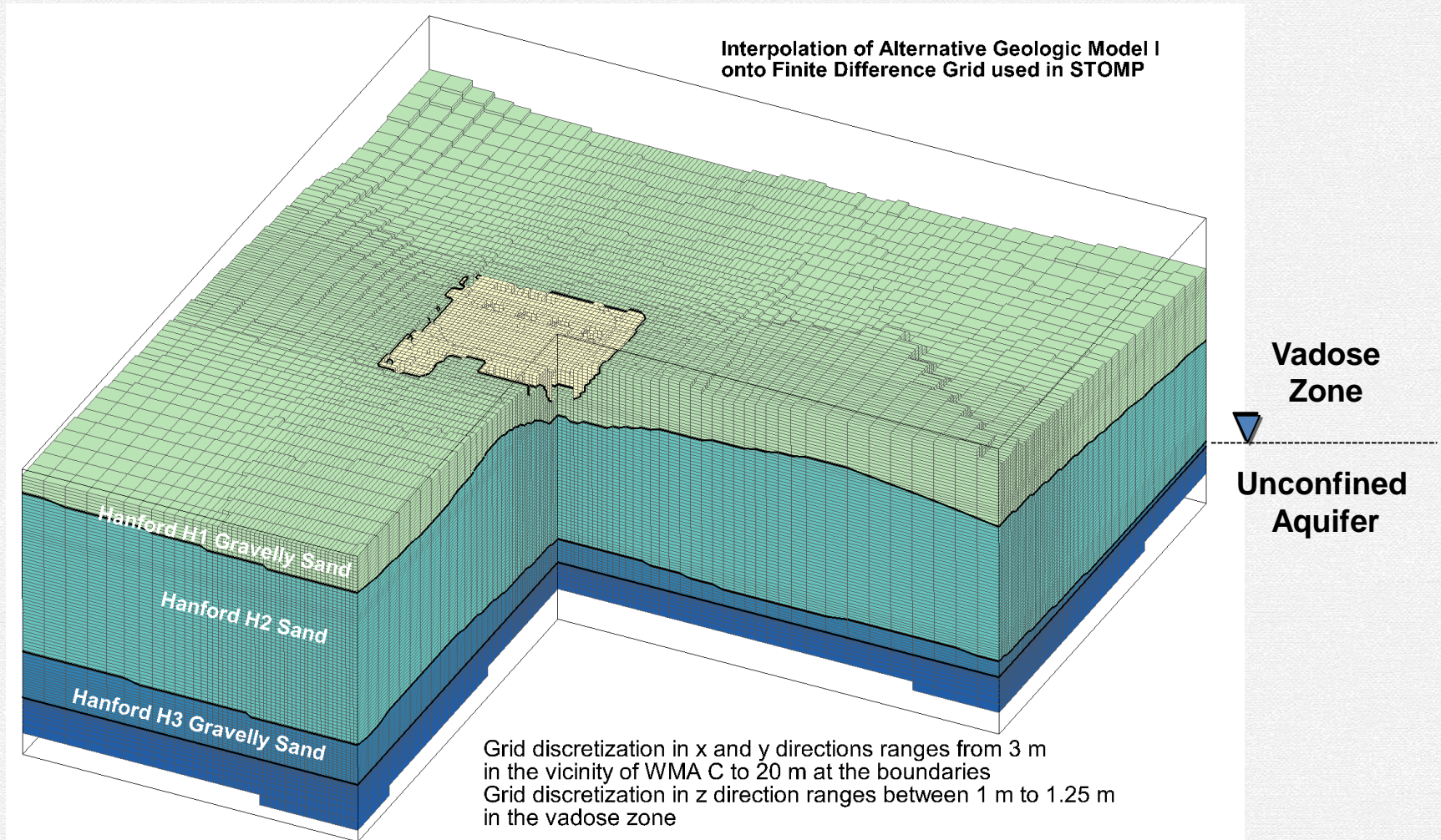
- **Denominator Case (Established in Scoping)**
  - Current estimates of tank residuals
  - Diffusion-controlled release for grouted tanks and equipment
  - Advection-controlled release for pipelines
- **Sensitivity Cases**
  - Selected tank degradation cases (diffusion-controlled to advection-controlled releases at selected tank degradation times after closure)
  - Selected recharge sensitivity cases
  - Selected upper bound residual inventories
  - Alternative hydrogeologic conceptual model sensitivity cases
    - Hydrogeologic conceptual model from Nez Perce Tribe
    - Highly heterogeneous representation







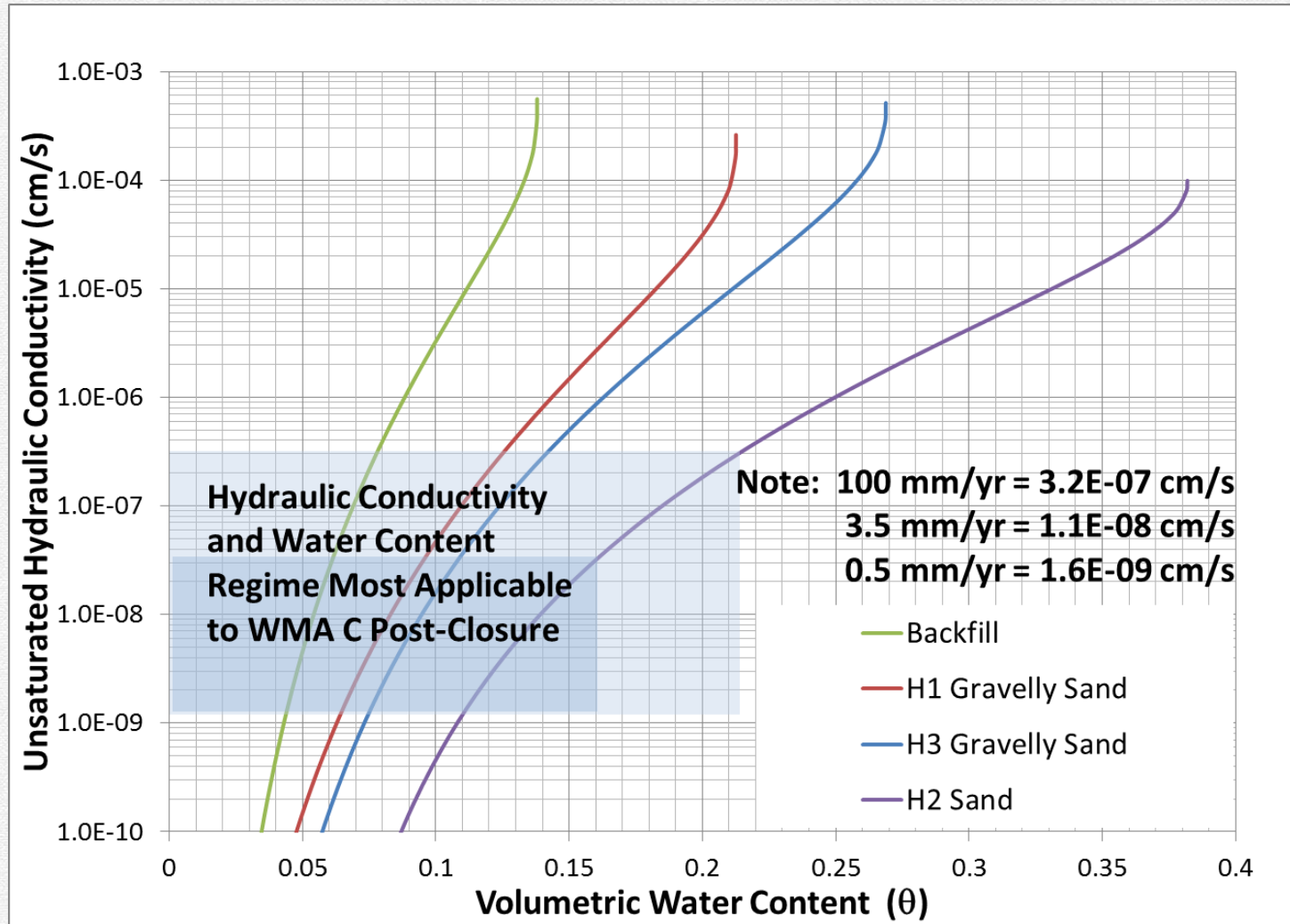
# Denominator Case Model Based on STOMP







# Hydraulic Properties of Waste Management Area C Model







## Denominator Case Recharge Rates

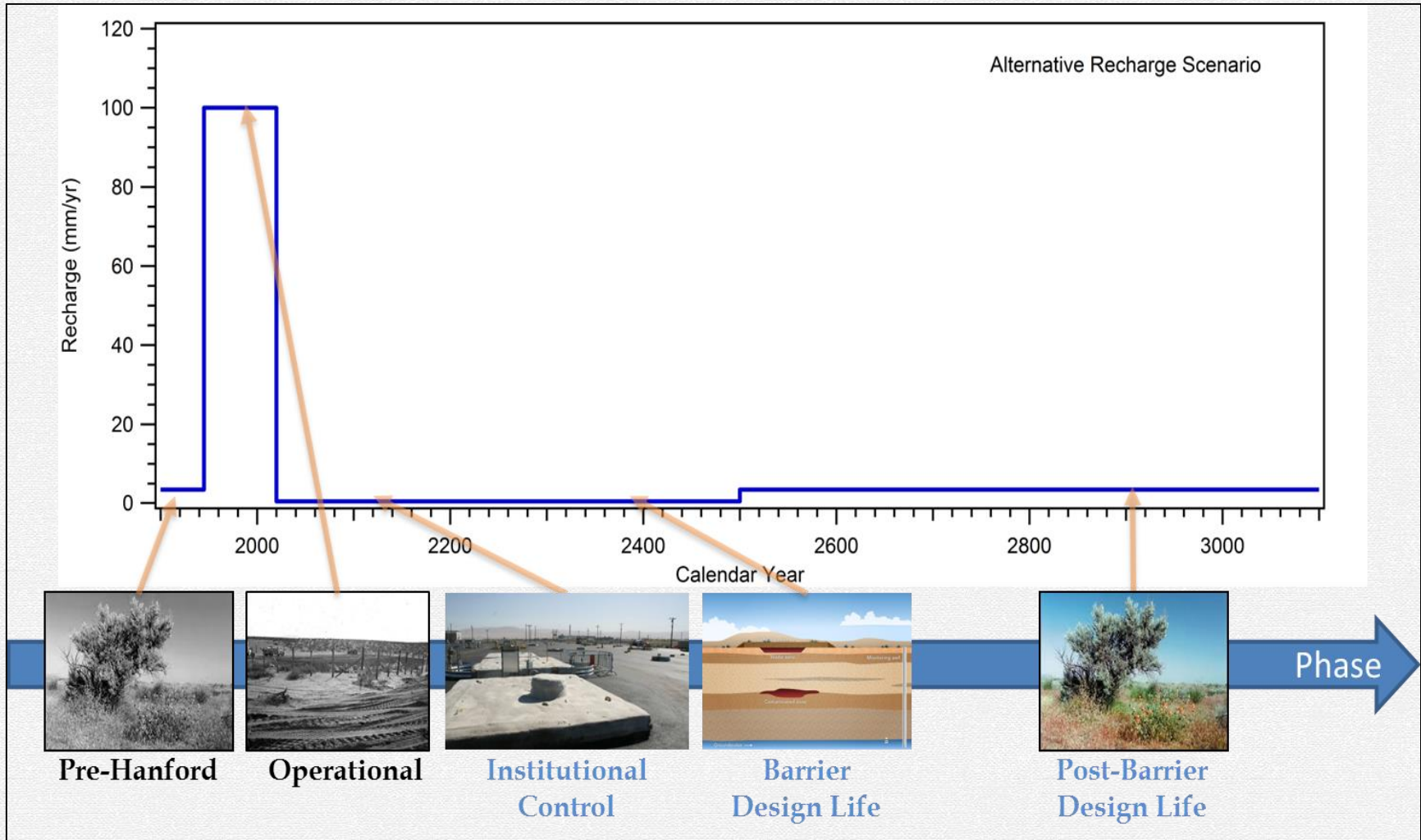
| Surface Soil Type       | Historic Simulation<br>(pre-2020)<br>(initial hydraulic conditions) |                                         | Predictive Simulation<br>(post-2020)<br>(calculation of peak groundwater concentration) |                                          |                                                |
|-------------------------|---------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------|------------------------------------------------|
|                         | Pre-Hanford Phase<br>(Before 1945)                                  | Hanford Operations Phase<br>(1945-2020) | Institutional Control Phase<br>(2021-2120)                                              | Barrier Design Life Phase<br>(2121-2520) | Post-Barrier Design Life Phase<br>(After 2520) |
| Hanford sand, disturbed | 3.5                                                                 | 100.0                                   | 0.5                                                                                     | 0.5                                      | 3.5                                            |







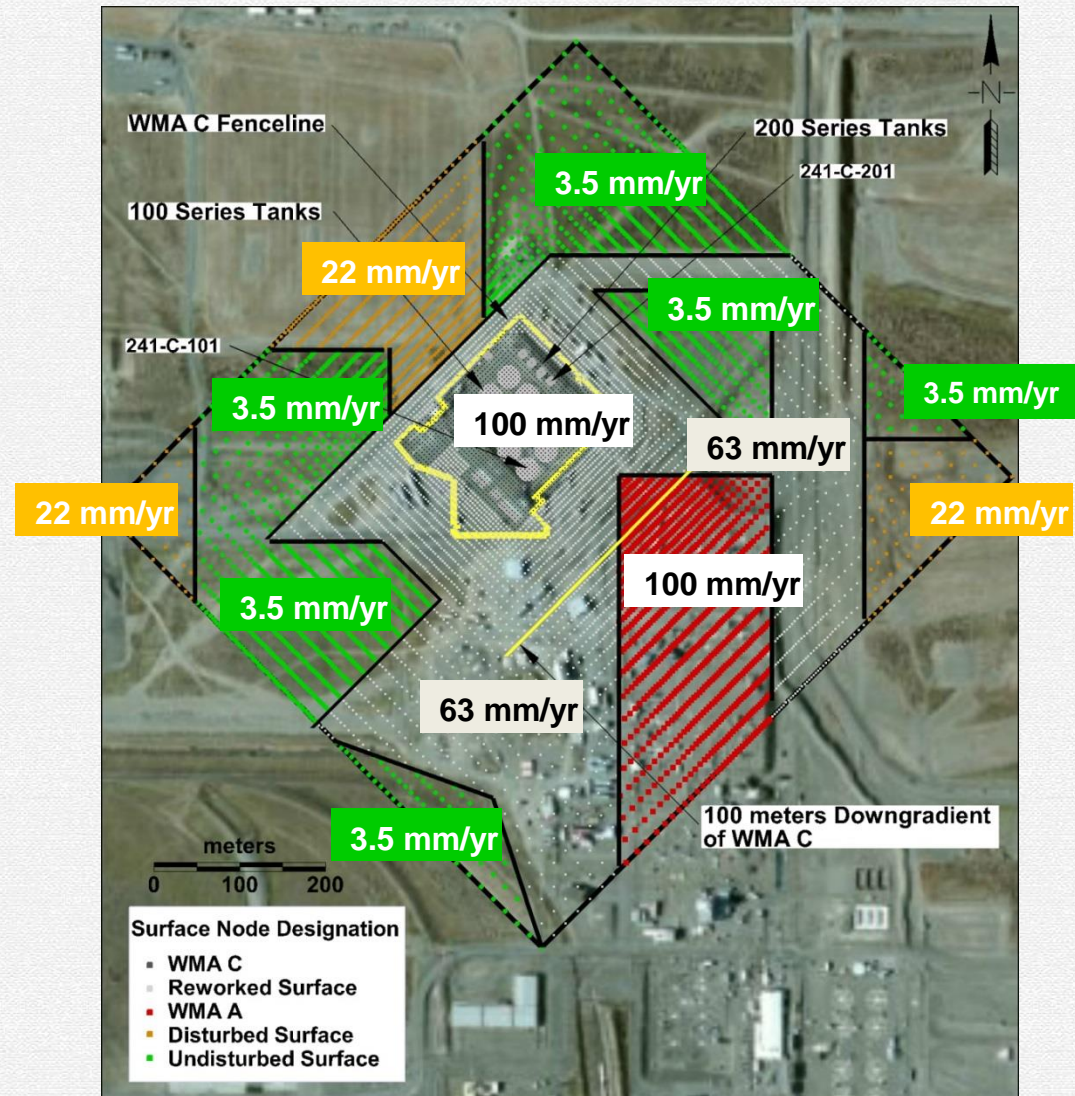
## Denominator Case Recharge Rates (cont.)







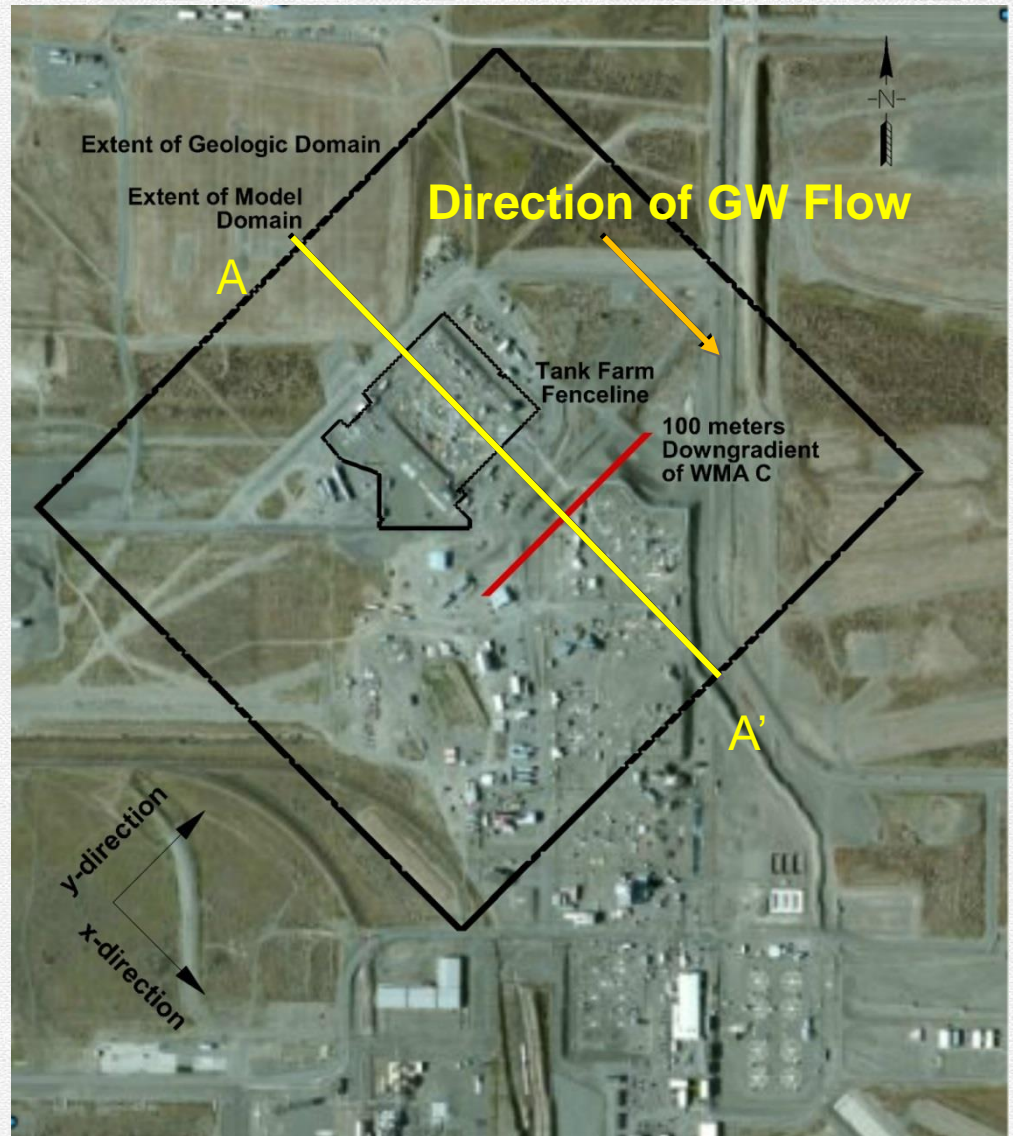
# Recharge Rates Outside of Waste Management Area C (Operational Period)







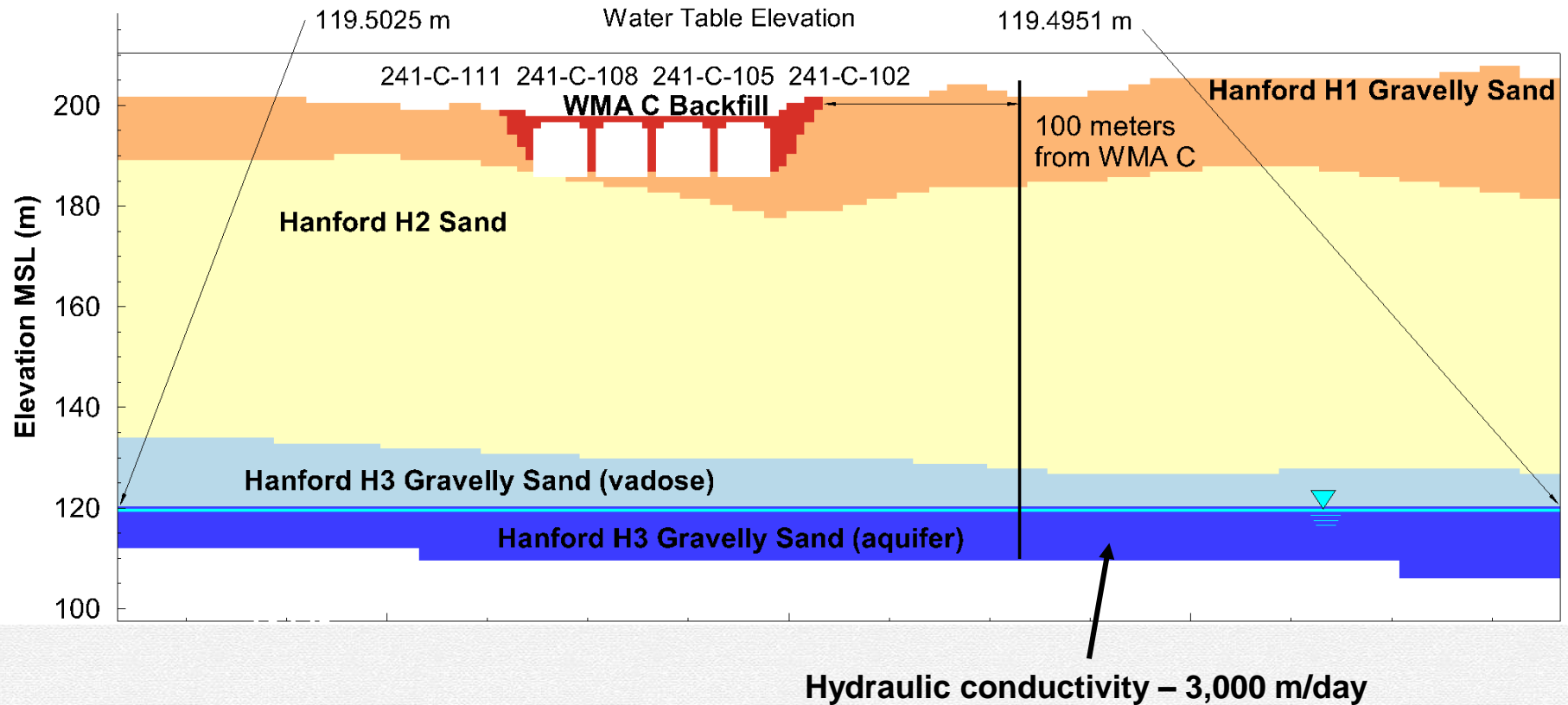
# Waste Management Area C Model Domain and Points of Calculation in Groundwater







# Unconfined Aquifer Properties

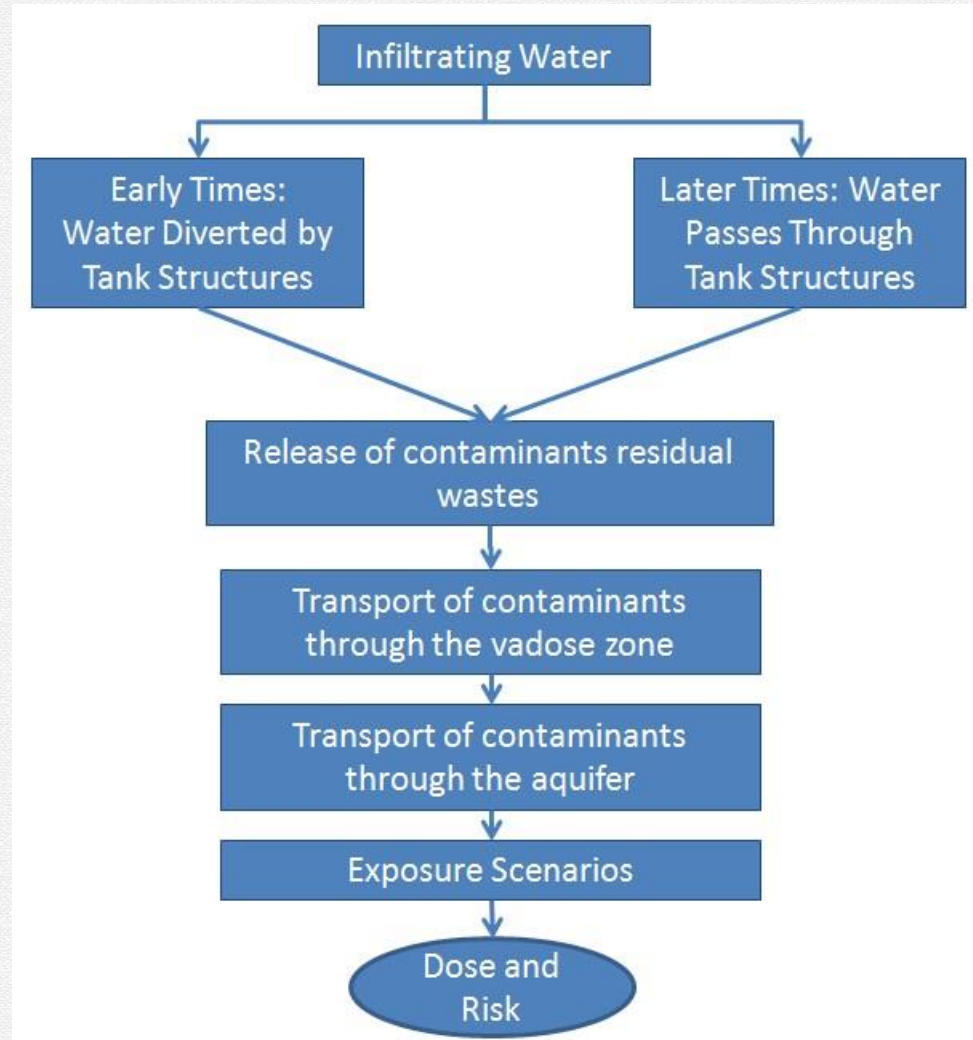






## Basic Modeling Approach

- Flow field (and select transport analysis) calculated with STOMP
  - Initial period (tanks intact)
  - Late period (tanks degraded)
- Flow field abstracted into GoldSim system model
- System model used for:
  - Release from residuals
  - Contaminant transport
  - Exposure-related calculations







# System Modeling Implementation Status

- Flow abstracted and evaluated in GoldSim-based system model
  - For intact and fully degraded tank cases
- Working system-level models for all sources
  - Twelve 100-series tanks
  - Four 200-series tanks
  - CR-vault
  - C-301 catch tank
  - Pipelines







## System Modeling Implementation Status (cont.)

- Waste release models implemented in system-level models
  - Diffusion-controlled release
  - Advection-controlled release
  - Release models from Pacific Northwest National Laboratory waste release experiments (technetium-99, chromium, and uranium)
- Exposure scenarios
  - All pathways
  - Air pathway/radon transport
  - Groundwater protection
  - Inadvertent intruder (acute and chronic exposure)





## Anticipated Performance Assessment Schedule

- **Complete and submit Performance Assessment, Rev. 0 documentation for tank residual impacts – October 2015**
  - DOE O 435.1 performance assessment for radiological impacts
  - RCRA closure analysis for hazardous chemicals impacts
- **Conduct Low-Level Waste Facility Federal Review Group and Washington State Department of Ecology review – October to December 2015**